25 May 32 Geo. II — Lrs Patent granted to Hy Wood of High Hercall in the County of Salop Clerk for an Invention of working a fire Engine upon a new Principle differt to any method heretofore used. & at less than ½ the expence of coals any method now used requires

23 July 1759 — The said Hy Wood caused a specification of his Invention to be inrolled in the following words viz.

I, the said Hy Wood Do hereby declare That my said Invention is to work a fire Engine on the principle of hot or rarified Air produced by the Air passing either thro' fire or thro' red hot pipes, or thro' boiling water, or by any other way heated or rarified. And Whereas hot Air may be conveyed into the great Cylinder of the Engine by differt ways either by help of Bellows or small Cylinders with proper piston & valves, or the pressure of the Atmosphere, will drive in Air thro' any heated Bodies as the piston of the Engine rises, & so fill the Cylinder with hot Air, wch must be condensed with cold, to produce a vacuum, & when condensed must be discharged out of the Cylinder & this discharge may be effected differt ways. If the hot Air be driven into the Cylinder with a force superior to the pressure of the Atmo. that force will drive out the condensed Air thro' what is now called the Snifting Pipe; if ye force be only equal, then the condensed Air must be pumped out by a Pump, to be worked by the motion of ye Engine or any other way; therefore my Invention is to work the fire Engine by any of ye above recited Methods or by any other way not now in use; whereof hot or rarified Air is ye Principal, or hot Air in conjunction with steam, wch must be unavoidable when Air is heated by passing thro' Boiling water, by the help of the Pipes.

A View of the Objections wch have been at various times urged against Mr Watt's Specification

From Bull's Answer in Chancery — Mr Bull in his Answer in Chancery to the Bill filed against him by Mess. Boulton & Watt sums up his objections in the following manner. Admits that he makes use of steam to press up the Piston in his Engine wch he conceives he has a right to do & that it is not an Invasion of the said James Watt's Invention, steam having been so applied & such application particularly described in Harris's Lexicon printed in 1700 Martin & Owen's works & several other philosophical works & ye said J Watt in his said specification also states that he condenses his steam by the cold of the Condenser to Condense the Steam, or if Water was injected by what method that water was to be discharged from the Condenser after it had so Condensed the steam. And the said Pet. J W. therein also states that the Pump was for the purpose of drawing out the Air or Elastic Vapour, but omits to mention its use in drawing off the water injected; therefore the Deft. conceived & still does conceive & submits that he has a right to make use of a Pump, when he sees occasion for the purpose of drawing of the Water after it has condensed the steam as the Pet. J W.'s specification is silent on the subject & that he has a right to draw out the Air or other elastic Vapr. by means of a Pump; that use of a Pump being made known in a specification enrolled in this Hble Court by ye Revd Mr Wood of [illegible] in the County of Salop under a Patent obtained by him in or abt ye year 1759 & described nearly in the very words used by the Petr. J. W., so that it is improbable ~~for the Petr.~~ J. Watt to assert, that such idea originated with him, & as to ye mode of applying it to a Fire Engine the said J. Watt's Specification is totally silent.

From Jabez Hornblower's & Maberly's answer in Chancery. — Mess. Jabez Hornblower & Maberly in their Answer in Chancery state their objections as follows viz.

Say they have been informed & verily believe & expect to be able to prove that ye said J. W. was not, as the Petr. pretends ye discoverer of ye Principle upon wch the Pet's Engines are constructed but that the same were known & in actual use before the said pretended discovery & Invention & before the said Lrs Patent.

Say, they apprehend & believe, that the said specification inrolled by the said J. W. is defective, or is no specification in many material respects; for, the Defts. say that ye said J. W. has in his said specification stated, that in Engines wch are to be worked wholly or partially by the condensation of the Steam is to be condensed in vessels distinct from the steam vessels or Cylinders, altho' occasionally communicating with them, but has not in his said specification inserted or set forth any description whatever of such vessels wch there ought to have been, as also the form & capacity thereof, the same being a matter of great importance to the perfection of the Petr. said steam Engine, nor has he inserted or set forth how & when the vessels in wch ye steam is to be condensed, are to communicate with the steam vessels or Cylinders wch is likewise matter of great importance to the well going & good effect of the said Engine & wch no Engineer or other Person cd understand without a particular description or instruction or many very expensive Experiments & Defts also say that in the said J. W.'s specification he has set forth, that whatever Air or other elastic Vapr. is not condensed by the cold of ye Condenser & may impede the working of the Engine, is to be drawn out of the steam vessels or Condensers by means of Pumps wrought by the Engines themselves, or otherwise but the Pet. J. W has not inserted or set forth any description whatever of ye said Pumps nor what proportion they are to have to any other of ye principal parts of ye Engine or how many Pumps are necessary nor how they are to be wrought than by the Engines themselves: nor has the said J. W. set forth in what cases he intended to employ the expansive force of steam to press on the Piston or whatever may be used instead of them wch defendts humbly insist he ought to have done, inasmuch as the said specification implies that there are cases to wch that mode of applying the steam is better or more preferable to others.

Deft. Hornblower says, he verily believes it is not possible to apply steam to a Piston in ye manner described or expressed in & by ye said specification. Deft. also says, that altho' the Pet. J. W. has in his said specification inserted, that ~~where~~ Motions round an Axis are required he made ye steam vessels in form of hollow rings or circular Channels with proper Inlets & Outlets, for the steam, mounted on horizontal Axles like the Wheels of a water mill, within wch were placed a number of valves: yet the sam J. W. has not in his said specification inserted or set forth any description of the said Inlets or outlets, or valves or where the same are, or ~~consist of~~; or how many ~~or~~ of such Inlets or valves are necessary, or where the same shd be placed & altho' he has also inserted in his said specification that in the steam vessels were placed weights so fitted to them as entirely to fill up a part or proportion of their Channels yet rendered capable of moving freely in them by the means there said to be after mentioned or specified the Pet. J. W. has not in such specification mentioned or specified those means. & altho' the Pet. J. W has inserted that when the steam is admitted in those Engines between the aforesaid weights & those valves, it acts equally on both, yet he has not set forth how or by what means the steam is to be admitted. And the Pet. J. W., ~~has in his~~ said Specification inserted, that he intended in some cases to apply a degree of Cold not capable of reducing the steam to water, but what such cases are, or when & in what manner the degree of Cold is to be applied, the Pet. J. W. has omitted to set forth & moreover Defts say that the Pet. J. W. has not in, or to his said specification inserted or subjoined any Drawing Plan or Dimensions of the differt parts of the said Engines wch Defts humbly insist he ought to have done & by reason of the omission thereof & of the several other omissions aforesaid, Defts also insist it is impossible for any person to conceive a proper Idea, or gain that knowledge of ye said Engine wch is meant & intended the Public shd gain by or from said Specification after the expiration of the said Term granted by ye said Lrs Patent & Act of Parliamt & Defts also insist the description of the Pets Engine is so imperfectly set forth in the said Specification that it is impossible

for any Engineer or other person to make or construct Steam or Fire Engines from such description in truth of which Defts crave leave to refer to the words of the Act of Parliamt. set forth as follows

"And whereas the said J. W. hath employed many years & a considerable part of his Fortune in making Experiments upon "steam & Steam Engines commonly called Fire Engines with a view to improve those very useful Machines by which "several very considerable advantages over the common Steam Engines are acquired: but upon acct. of the many "difficulties which always arise in the execution of such large & complex Machines & the long time requisite to make "the necessary trials he cd not compleat his Intention before the end of the year 1774

1774

Which words are in the Defts opinion sufficient to the conviction of any unbiased Person, that the said Specification was so incompetent to instruct any other Engineer in the Erection of the Pats Engine that it cd not instruct the said J. W. himself & that therefore the said Specification is not a proper specification according to the said Letters Patent

from the affidavits of Hornblower & Maudsley(?) & witnesses on the motions in Chancery in this Cause

Their several Witnesses state their respective objections by their differt. affidavits as follows vizt.

Jonathan Hornblower Engineer. His objections are these

1o. The Specification not sufficient without Experiments

2o. That Directions & Instructions cd have been given in the form of a Specification or by figures or references.

3o. That several of the Principles were known & in use before the Patent vizt.

this he states from his own Knowledge:

(a) The use & substitution of steam in lieu of the Atmosphere as the impelling Power to move the Piston.

(b) The use of Grease & Oil on the Piston for the facilitating its motion within the Steam vessel.

(c) The use & practice of surrounding the Cylinders or steam vessels with heated Bodies

this from hearsay:

(d) The application of water for the purpose of condensing the steam in such manner as to effect that purpose without permitting the Water to enter the steam vessel."

Jethro Hornblower Works Engineer His objections are 1o. Experiments necessary

2o. some articles inserted in the Specification for rendering the Piston or other parts of the Engines air & Steam tight, which if used absolutely render the Engine of no effect

Jesse Hornblower Engineer. This Person seems to think nothing of the Objections stated by his Brothers Except as to the necessity of Experiments & that a Specifon by Drawings &c. was practicable which are the only objections he states; by which he appears to negative the other objections.

Arthur Woolf Engineer servant to Jabez Hornblower. This witness states 3 objections 1o. Experiments necessary

2o. Specification by Drawings &c. practicable.

3o. A pump used for extracting Air & condensed Vapours before Mr. Watt obtained his Patent, by Henry Wood. 1759

Jabez Hornblower the younger. Calls himself Engineer. This witness is a young man the son of Deft Jabez Hornblower. He seems to make up for the deficiency of his Uncle Jesse. He states a multitude of objections.

1o. That the Specon does not describe the Engine but the principles without stating the manner of applying the principles so as to enable any other person to form an organised Instrumt. thereof 2o. Experiments necessary

3 That the Specifon of the Motions round an Axis is more calculated to perplex than inform the Reader

4 That the working of the Engine by the alternate expansion & contraction of steam was unknown to Mr. Watt himself or purposely kept back to this day.

5 Rosin, Quicksilver & melted Metals, highly injurious. 6 These Articles not used by the Pats but Oil & Grease only.

7 That Oil & Grease were used abt. Fire or Steam Engines long before the Pats Patent

8 That the most complicated Machines may be explained by Figures or Drawings wit references.

9 That the Specon does not afford the smallest information or instruction respecting the nature of the Invention especially the manner in which the same is to be performed

Thomas Stroude Engine & Pumpmaker. His objections are 1o. Experiments necessary

2 That a Specifon might have been given by Figures & References 3o. The Pump used before by Henry Wood.

4 Some of the Articles for rendering the Piston & other parts of the Engines Air & Steam tight which be highly injurious or totally destructive of the Engine.

Dr. Watson Engineer. his objections are 1o. Principles only & not the manner of applying them set forth

2o Experiments necessary 3o. The fifth Article impracticable.

4. Alternate Contraction & Expansion of Steam unknown to Mr. Watt or withheld to this day

5 Rosin. Quicksilver & melted Metals improper & not used by the Pats. who uses Oil & Grease only

6 Grease used abt. Steam Engines before Mr. W's Patent 7. That the most complicated Engines may be described by words & drawings

8 That the Specon does not contain the smallest information or Instruction &c. especially as to the manner in which the invention is to be performed.

Thomas Recontree Engine maker. A witness of the first trial. His objections are 1o. Henry Wood's Pump used before Mr. Watt's Invention

2 The expansive force of steam adopted by Captain Savary in 1701

3. The general manner of the Specon intended to take in any future improvement

Joseph Bramah This eminent Water Closet Maker who calls himself an Engineer states his objections as follows. 1o. want of Organisation

2 The rotary Steam Wheel cd not possibly answer the purposes of a Machine 3 want of Organisation repeated

4. That a Specification by Figures & References was practicable 5. The prior use of some parts

Note (a) The Pump by Henry Wood (b) The Steam acting instead of the Atmre. was adopted by Capt. Savary (6) Melted Metals &c. improper

Mr. Bramah winds up his objection with a long paragraph of which it is impossible to give any Idea whatever but in his own words which are much too curious to be passed over

saith that the ultimate effect of all Mechanical Apparatus & most especially of the Steam Engine depends on peculiar Organisation & proportion, & on this fundation rests all invention, & unless these two fundamental points be especially ascertained by delineation & demonstration, no invention can be discriminately understood: for this Depont. is of opinion that to claim an Invention not described, it may be any thing the Claimant finds will best suit him, & Deponent further thinks that Pat. claiming his intended application of Steam & not describing his Engine, is, as tho' he had taken a Patent for every new application or combination of the Mechanic Powers without exception: for, as every new effect in Mechanics is the consequence of a differt. proportion & combination of parts possessing unalterable Properties & on which some known force is to act, so every new effect producible by the power of Steam or other Elements, must bonâ fide depend on the peculiar proportion & organization of the Engine or Machine in which the said steam &c. is to be employed, as no new Properties can be given to the Elements; consequently all new effects producible by the varied application of those powers must depend wholly on material construction & certainly such Construction can be rendered intelligible to Man of adequate skill by Description Drawings &c.

Wm. Braithwaite: Wm. Braithwaite Jr. & John Braithwaite (2 of these were wit. on the 1st trial) Engine & Pump makers These Deponents jointly state the following objections vizt.

1o. Experiments necessary 2. Specification by Figures & References practicable.

James Brown Gentleman This Gentleman's objections are. 1. Experiments necessary

2. That the Specification does not state the application of water to the inside of the Condenser nor how the water was to be discharged.

3 That the Specifon does not state in what Cases the expansive power of Steam was to be employed

4 That he believes that the Pat. has never been able to manufacture an Engine moving on an Axis according to the 5th Article & that no one can from the description alone ever accomplish it 5. Rosin & Quicksilver improper

from the Answr. in Chancery of Oxnam & others Co-defendts with Bull

Messrs. Oxnam & others Co-Defendts with Mr. Bull in a suit in Chancery, have summed up their Objections as follow vizt.

1o. To the Invention 2. To the Patent 3. To the Specification 4. To the Act of Parliamt.

1o. To the Invention: That the Pat. J. W. was not the Origl. Inventor. Dr. Roebuck the Inventer

Say, they have heard that the said J. W. was not the Origl. Inventor of the method of lessening the consumption of Steam & Fuel in the working of Steam or Fire Engines, for which he applied for, & obtained the said Lrs. Pat. but that the same was invented by Dr. Roebuck & that instead of their being intitled to such exclusive privilege that the said Patent was bad in Law, for various reasons, & amongst other objections thereto Defts. are advised.

2. To the Patent: a) that a Pat. cannot be legally granted for a principle b) or for a mere Improvemt. c) or at least that the Pat. which is not an Improvemt. for which a Pat. cd be granted as it is a Principle merely & not a Manufacture

That Patents cannot be legally granted for a Principle merely, as is the Case in the presnt. Instance or for a mere Improvemt. of Engines previously in use. or if so, that the Improvemt. alledged to have been made by the said J. W.; at least is not of the description which can be the subject of a Pat. even if discovered by him; the same being a Principle merely & not a Manufacture, & that H. My. was therefore deceived in this Grant & particularly by not being informed that it was for an Improvement only & the said Lrs. Pat. are not within the Protection of the Act of Parl. 1st. & even if the said Pat. was good, which the Defts. do not admit, that the said Compl. did not comply with the Proviso therein contained, by which it was required that the said Compl. J. W. shd. inroll a particular description of the said alledged Invention & the manner in which the same shd. be performed & used, & that the instrumt.

3. The Specification

involled by the said Compl. J. W. in the said Court of Chancery as aforesaid as such Specification is defective, vague uncertain & in many respects unintelligible & amongst other objections thereto that the said J. W. altho' he states therein "That he condensed the Steam by the cold of the Condenser by the application of water & other cold Bodies" yet does not add that he injects water into the condenser or by what means the water was to be discharged from the Condenser after the Steam had been thoroughly condensed & altho' he therein states that the Pump was for the purpose of drawing ~~off the water injected~~ out the Air or elastic vapours he omits to mention its further use in drawing off water injected in the Condenser, & is silent as to the manner of applying the same to a Fire Engine, & if the Compls. pretend, that the said Lrs. Pat. were granted, not for a Principle but for a Machine or Engine, then these Defts are advised & submit, that the said specification is further defective in as much, as no Engine is therein described or any representation of the alledged Invention or improvemt. when applied or in what the addition to the Machines previously in use consisted, or where it differed therefrom but defectively describes Principles or methods only & those he had in contemplation rather than those he had actually adopted & that no Machine cd have been made from such specification with equal effect with the Machine made by the said Compls. without various Experiments & these Defts. are further advised & submit. that altho' the said Letters Patent were for a Principle only, the said Act of Parliamt. was obtained for a Fire Engine & therefore that the same was not continued thereby & that the Parliamt. was deceived therein. And Defts. further say they have been informed & believe, that by the said Act of Parliamt. it is among other things noted that the said Compl. cd not compleat his Intention before the end of the year 1774, when he finished some large Engines as Specimens of his Construction & that, by the said Act ~~of Parliamt.~~ it is provided that every objection in Law, competent against the said Patent shd. be competent against the said Act, to all intents & purposes, except so far as related to the Term thereby granted, & these Defts. therefore are advised & submit, that in as much as the said J. W. did not after passing the said Act, ever inroll any new Specification of the said alledged Improvements which are therein recited not to have been compleated till the end of the year 1774, that the want of the Inrollmt. of such new Specification is an Objection compet. to the said Act as the want of Specification or the Inrollmt. of a defective Specification is an objection in Law compet. to the said Lrs. Pat. & all Liberties & Advantages whatsoever thereby & by the said Act of Parliamt. granted have utterly ceased determined & become void & so remain.

a) the Specon does not state that water was to be injected into the Condenser. b) nor by what means the water was to be discharged from the Condenser c) That the Specon does not state that the injected water was drawn off by the pump & is silent as to the manner of applying the same to a Fire Engine d) If the Plts alledge that the Pat. was not for a principle but a Machine or Engine that the Specon is further defective in as much as no Engine is therein described & that there is no representation of the alledged Invention or Improvemt. when applied or in what the addition to the Machines previously in use consisted or where it differed therefrom. e) that the Specification describes Principles only & those the Patentee had in Contemplation rather than those he had actually adopted. f) That no Machines cd have been made from such Specifon of equal effect with the Machines made by Pat. without various Experiments.

4o. To the Act of Parliamt. a) That the Pat. was for a Principle only but the Act is for a Fire Engine & the Parliamt. deceived b) That it appearing the Act, that the Pat. J. W. did not compleat his intention before the end of 1774 when he finished some large Engines as Specimens of his Construction & that as the Act contains a Proviso that all objections competent against the Patent, shall be compet. against the Act that the Patentee did not after the Act, inroll a new Specification of the Improvements which were not compleated till 1774 or the inrollmt. of a defective one is an objection competent in Law to the Letters Patent

Observations

Jonathan Hornblower who objects to Mr. W's Specification for want of Drawings &c. obtained a Patent in the year 1781 for a pretended Invention of which he inrolled the following Specification.

To all to whom these presents shall come &c. Now know ye. that in compliance with the said Proviso & in pursuance of the said Statute I, the said Jonathan Hornblower do hereby declare, that my said Invention is described in manner & form following that is to say

1st. I use 2 vessels in which the steam is to act, & which in other steam Engines are generally called Cylinders

2dly. I employ the steam, after it has acted in the 1st. vessel, to operate a 2d time in the other by permitting it to expand itself, which I do by connecting the vessels together & forming proper Channels & Apertures whereby the steam shall occasionally go in & out of said vessels

3dly. I condense the steam by causing it to pass in Contact with Metalline surfaces while Water is applied to the opposite side

4thly. To discharge the Engine of the Water used to condense the steam, I suspend a Column of water in a Tube or Vessel constructed for that purpose on the principles of the Barometer; the upper end having open communication with the steam vessels & the lower end being immersed into a vessel of water

5thly. To discharge the Air which enters the steam vessels with the condensing water or otherwise I introduce it into a separate Vessel, whence it is protruded by the admission of Steam

6thly. That the condensed Vapr. shall not remain in the steam Vessel in which the steam is condensed I collect it in another vessel, which has open communication with the steam vessels & the water in the Mine Reservoir or River.

7 Lastly, in Cases where the Atmosphere is to be employed to act on the Piston I use a Piston so constructed as to admit steam round its Periphery & in Contact with the sides of the Steam vessel thereby to prevent the external Air from passing in between the Piston & the sides of the Steam vessel In witness &c.

Though several of the Witnesses now brought forward call themselves Engineers there is not among them one Engineer of character or ability. Most of those who call themselves Engineers are mere Pump Makers & inferior Artists

Watson: Whatever the witness W. knows of Engines, he learnt from Boulton & W. He is not a man of character & comparatively little Knowledge.

Recontree: Was a witness in the 1st. trial: Being asked by Mr. Rous whether he understood the effect of Steam, he answd. "In some measure. I do not call myself an Engineer" And yet Mr. Rous drew from this man such further replies as showed that all the Mechanical means that were necessary to Mr. W's Engine were in use in Newcomen's Engine & perfectly familiar to Mechanics

Recontree has been publickly accused by Bramah of pirating some of his pretended Inventions.

Bramah: From this man's examination on the Trial, it evidently appeared he came prepared to make the most of the objections. yet even he admitted it was a good Text to enlarge upon. He said " I have no doubt from that Text I shd. have been able to improve Newcomen's Engine. The Hints there given would have much forwarded my improvements" Being asked upon cross examination whether a Mechanic commonly skilful cd make an Engine from the Specification? he said "He might make an Engine" & further "I have no doubt " but the hints here point out the defects tacitly of the old Engine" & further "If I had had this put into my hand when it was first wrote " I cd have made a good use of it, probably. I might have invented a much better Engine than is now known in the world in consequence of it"

All this is mixed with observations of the witness which are in fact flatly contradictory to the passages here quoted. The witness having admitted that an Engineer cd make an Engine from the Specification tho' he cd not tell what sort of an Engine, he wd be extremely puzzled to shew, how such an Artist cd mill making an Engine possess Mr. Watt's Improvements

The Braithwaites John Braithwaite admitted upon ye former Trial, that he had never made a Steam Engine.
His Brother & Partner Wm being asked, whether from Mr Ws Specifon he cd make the Engine that Mess. Bts & W. use? He said
" I am not certain that I cd make an Engine, but I am not certain that I wd come near that In makg this Engine I shd have a variety
" of Experiments to make, before I cd bring it to any thing, before I cd know whether it wd answer the purpose it was intended for
Wm Braithwaite, upon his cross Examination being asked "Whether knows the principle of Newcomen's Engine & seeing Mr Ws
" specification, cd you make one, to condense the Steam in a separate Vessel?" He replied "Yes I cd."
Qy "Cd you draw out the Air by means of a Pump? A. "this might be applied, but not very likely in the way that he has pointed out"
Qy "Then I am to understand you, that all wch you cd not do wd be this. That you cd not certainly apply it in that precise form in wch you see it upon the
" drawing? A. I cd not"
Qy "But cd you with certainty produce the effect of pumpg it out?" A. "yes, I suppose I cd"
J. Brown Gentleman This witness not profess to be a practical Engineer is not likely to gain much credit with a Jury, when he states the specification to be insufficient in opposition to ye practical Engineers of Eminence who say the sd specification is sufficient

Answers by Mr Watt to the Objections made to his Specification

1st by Mr Bull The Engine described in Harris's Lexicon Technicum, is Savary's, who indeed did employ the elastic Power of Steam to press upon the water to be raised; but his Engine had no Piston nor any thing wch ressembled one (see the Book) & this Misrepresentation Mr Watt endeavoured to obviate, by a Memorandum annexed to the Specification wch says, that the 4 Article shd not be understood to extend to any Engine where the Water to be raised enters the Steam vessel itself or any vessel having an open communication with it.

As to Martin & Owen's Works, it is presumed a Dictionary under that name is meant wch was produced in ye Court of Common Pleas wch contains nothing relative thereto, except a very bad description & small print of a Newcomen's Engine, very incorrectly copied from Clare upon Fluids, & seems an Engravg of a Model for Philosophical Experiments (wch Books see) & every true Mechanic must once see that the Engine so described in Owen cd not act at all.

The specification of the Revd Mr Wood does not relate to a Steam Engine, but to an Engine to be wrought by heated Air or by Air & Steam mixed, by Air being forced thro' boilg water. It is believed that such Invention is impracticable & was never carried into Effect by any body: at least Mr Watt was ignorant of it altogether until a few days before the last Trial.

As a genl Answer to ye Objections of the defect of the Specification, the best way seems to give a short History of the Invention & Mr Ws then Ideas of the application to the existg Steam Engines.

Mr Watt found, that a well made Brass Model of Newcomen's Engine consumed Quantities of Steam & Fuel out of all reasonable or direct proportion with larger Engines. He consulted Desaguiliers natural Philosophy & Belidor's Architecture Hydrauliq. the only Books from wch he cd hope for information: he found, that both of them reasoned learnedly but by no means satisfactorily; & that Desaguiliers had committed a very gross Arithmetical error in calculatg the Bulk of Steam from the water evaporated in a common Steam Engine, wch being rectified it appeared next, that his data or assumed Facts were false.

By a simple Experimt Mr W. found what was the real bulk of water converted into Steam & from his friend Dr Black, he learned what was the heat absorbed & rendered latent by ye conversion of water into steam, wch the Dr then publickly taught & had done for some years. Experiments had been made before by Dr Cullen Mr John Robison & others in public Classes wch proved that water when placed in an exhausted Receiver boiled & was converted into Steam at the heat of 70 or 80° of Fahrts Therm.r while it was well known that under the pressure of the Atm.re it required 212° of heat, to make it boil & emit steam capable of displacg the Air.

It was evidt that under intermediate pressures, intermediate degrees of heat wd be required to make it Boil & that in ye Steam Engine more or less cold water must be thrown in, accordg to ye degree of exhaustion wch might be required or in other words accordg to ye number of pounds per Inch the Engine was loaded to.

Newcomen's & Savary's Engines existed: the latter were in general laid aside on several Accounts, but the principal one seems to be, that the cold water (ye raisg of wch formed the effect of the Engine) entered the Steam vessel itself. It in general was not a Cylinder but was of an Oval or egg form, & by coolg it destroyed a great quantity of steam when it came next to be filled wch Desaguilliers expressly Notices. This Engine however has an Injection of cold water to commence the condensation of ye Steam & Savary seems to have been the Inventor of that valuable Article, but he also seems to have condensed the Steam by pourg cold water on the outside of his Copper Steam vessel.

In Newcomen's Engine, the Steam vessel was a Cylinder or so, meant to be. A Piston was suspended moveable in that Cylinder: This Piston hung by chains to the Arch of a strong double ended Lever, like a scale Beam, to the other end of wch the Rods wch wrought the Pump were suspended in the like manner. The Steam was admitted from a covered Boiler thro' a Pipe into ye Cylinder below ye Piston The Air was blown out by the Steam at a Pipe near the bottom of the Cylinder called the Snift. The passage from ye Boiler was shut. Cold water was spouted or injected into ye Cylinder from a Cistern placed higher. The Steam was thus Condensed or rendered less elastic the other end or mouth of the Cylinder being open, the Pressure of the Atm.re not being resisted by an equally elastic Fluid within or under ye Piston weighed upon the latter & caused it to descend; wch by means of the lever, drew up the Pump Rods & raised ye Water The Injection Cock or valve was then shutt. The Steam Regulator or valve was opened, Steam was readmitted, the Equilibrium of Pressure upon the upper & under sides of the Piston was restored & ye superior weight of ye Pump Rods by means of ye Great Lever or workg Beam drew the Piston to the top of the Cylinder & the operation recommenced. When the Piston was at ye bottom of ye Cylinder ye Air wch entered with ye Steam & with the Injection Water was blown out at the snift, & ye hot water left in ye Cylinder was expelled thro' another Pipe called ye Eduction Pipe wch proceeded from ye bottom of the Cylinder several feet downwards & its lower end stood in a Cistern of Water & was furnished with a valve to prevent Regress.

The Steam valve & the Injection Cock were opened & shut by certain Mechanism called ye workg Gear wch was put in Motion by means of Pegs in a piece of Wood, wch was hung to & moved with ye workg Beam & was called ye Plug Tree.

In order to supply the Engine with Cold water it wrought a Pump called a Jack Head Pump wch was shut at ye top, by an Iron cover & its Pump Rod, thro' a collar of Oakum wch permitted ye Rod to slide up & down while it precluded ye exit of ye water wch was raised to a greater height, thro' a side Branch turned upwards. Thus the latent heat of Steam was discovered & published by Dr Black.

The Boilg water in vacuo at low degrees of Heat was discovered & published by Dr Cullen, Mr Robison & several others: The Elastic Power of Steam were known to Hero of Alexandria & to many ancient writers. The Steam Engine was invented by ye Marquis of Worcester, Savary, Papin & Newcomen

The means of confing Steam & ye makg valves cocks & Regulators were known to all of them. Pumps to draw both air & water out of vessels & Reservoirs were well known to everybody. An Air Pump with a Piston Rod movg thro' a collar was invented & publish'd by Mr Smeaton, & ye same Method even before him was commonly used in ye Jack head Pumps of common Steam Engines & in other Machines *

A Cylinder & moveable Piston were used in Newcomen Engine. — So were ye workg Beam & workg Gear or Machinery for opening & shuttg the valves & Cocks.

The steam was condensed by a spout of cold water in Savary's & in Newcomens Engines & as it is said in Desaguiliers, cold water was poured on the outside of the Steam vessels for the same purpose. Every body knew cold Bodies of all kinds condensed Steam when they came in contact with it

* This relates to ye Piston Rod of ye Cylinder, for, in respect to ye Air Pump it is not necessary tho' convenient that it be shut at top.

There were Pipes in all those Engines wch admitted ye Steam from ye Boiler & Cocks or Valves wch shut it out from that vessel & in Newcomen's Engine there was a Pipe wch conveyed away ye cold Water & a valve wch prevented ye Regress.

The Diameters of these Pipes wch admitted the Steam & let out the Injection water had been ascertained sufficiently near, ye Size & form of Boilers wch answered sufficiently well, had been also ascertained.

Of all these things Mr Watt must say "non ea nostra voco" — The things that are *his* remain to be told.

He (Mr W) found by the application of ye Knowledge wch has been mentioned; that ye Cause of ye great consumption of Fuel was, that ye Cylinder being cooled by ye injection water, that Vessel must condense a large Quantity of Steam whenever it was attempted to be again filled with Steam. That ye vacuum cd not approach ye perfection without the Steam was cooled below 100°, & that such coolg wd increase ye Evil complained of, in a fourfold or greater Ratio; because ye Penetration of ye Heat or Cold into ye Cylinder, wd be, as the square of the differences of the Heats between that vessel & the Steam. How was this to be avoided? He tried to make the Cylinders of Wood or other Materials wch conduct heat slowly; but he cd not prevent ye steam from comg into contact with the comparatively cold water wch remained at ye bottom of ye Cylinder & wch must be Expelled by the Steam. besides his wooden Cylinders did not seem likely to be of long duration.

In such like Experiment, he spent much time & more Money than was suitable to his circumstances, yet he made no advances towards a beneficial Discovery. But the matter havg got firm hold of his Mind & his circumstances obligg him to make Exertions to regain what he had spent, he turned the matter over, in every shape, & laid it down as an Axiom. That to make a perfect Steam Engine it was necessary the Cylinder shd be always as hot as ye Steam wch entered it, & that ye steam shd be cooled below 100° in order to exert its full power. The gain by such construction wd be double: first, no Steam wd be condensed on enterg ye Cylinder *2dly* ye power exerted wd be greater, as it was more cooled. The postulata, however seemed to him to be incompatible, & he determined to grope in ye dark, misled by many an Ignis fatuus, till he considered that, Steam being an elastic fluid, it must follow the Law of its kind; & that, if there were 2 vessels A & B of equal or other dimension, one (A) filled with steam & the other (B) exhausted, if a communication were opened between these vessels the steam wd rush from the full one into the empty one, & they both wd remain ½ exhausted (if the vessels were equal) or be filled with steam of ½ the density. If then into ye 2d vessel (B) an injection of cold water was made or cold water applied to its outside in sufficient quantity, ye portion of steam wch it contained, wd be condensed or reduced to water, & by the same Law of Nature that had operated before, more steam wd issue from A into B until ye whole was condensed & nearly a perfect vacuum established in both vessels, yet as ye cold water had not entered or touched A, that vessel wd still retain its heat. This idea once started, ye rest immediately occurred, ye vessel A being supposed to be the Cylinder, B. wd be ye vessel called now ye condenser The water, air &c accumulated in B, he immediately saw cd be discharged or drawn out by means of a Pump, or ye water might be run out by a pipe more than 34 feet long, going downwards & ye Air might in that case be expelled at a valve by fillg B with water, provided the descendg eduction pipe were shut mean while. On the whole however he approved the Pump.

Another difficulty appeared wch was ye makg ye Piston tight. that cd not be done with water as in Newcomen Engines, for, that might get in & evaporate & produce steam, he therefore thought of wax, oil & similar substances, as substitutes knowg that they wd not evaporate in ye heat of boilg water & for ye greater security he proposed to employ the steam itself, as ye actg power on ye Piston

The Diameter of the Pipes necessary to convey ye steam into & out of ye Cylinder, he regulated from those in use, the size of ye Condenser he assumed at Random, as he did that of ye air Pump, wch last it was evidt must be larger than was necessary to contain ye water & probable quantity of Air.

All this passed in his mind in ye course of a few hours, & in a few days he had a Model at work with an inverted Cylinder wch answered his expectations & was as far as he remembers, equal in its properties of savg steam to any he has made since, tho' in pt of mechanism much inferior. Very simple Cocks were employed as regulators or steam valves, & his Air pump & Condenser were of tin Plate. His Cylinder however was good & of brass 2 Inches diameter & a foot long. The Cocks were turned by hand instead of being wrought by ye Engine.

If Mr Watt is thought worthy of Credit in this matter, & ye facts are consequently allowed, where was ye mighty difficulty of puttg ye Invention into execution, from even fewer data than he has put in his Specification? He is not so presumptuous as to think, that there were not & are not numbers of Mechanics in this Nation, who from the same or even fewer hints wd have compleated a better Engine than he did. Mr Bramah has proved he cd, & Mr W. is inclined to believe him, but Mr W. does not pretend that any body cd have done it, without thinkg upon it, nor without much previous knowledge & some experience of similar things.

Had Mr W. been contd with ye Mechanism of Steam Engines as they then stood; his Machine might soon have been brought before the public: but his mind ran upon makg Engines *cheap* as well as *good* & he had a great hankerg after inverted Cylinders & other Modifications of his Invention wch his want of experience in ye practice of Mechanics, in great, flattered him wd prove more commodious than his matured experience has shown them to be; he tried therefore too many fruitless experiments on such variations. He wanted experience in ye construction of large Machines, that he endeavoured to acquire, but experimental knowledge is slow growth, & with all his Ingenuity so much boasted to his prejudice he was concerned in makg some very indiffert Common Engines. Other avocations to him ne-cessary, obliged him to turn his attention from ye subject, till he obtained ye Patent, so that, at that time he had made no advances in ye Improvemt of ye Mechanism. He therefore thought it proper to specify only what was his Invention & to leave any Mechanical Improvements he might make to be secured by other Patents if worthy of them.

His Idea then was to apply his Invention to ye Steam Engines as they existed: for this purpose, there was nothing else necessary than to shut up ye Snift, to apply a Regulator or Valve to ye openg of ye Eduction Pipe within ye Cylinder; an Air Pump to ye other end of that Pipe, & to eject into ye upper part of ye Eduction Pipe. If at ye same time ye Cylinder was defended from ye Cold of ye Atm.re, ye Engine wd thus be compleat. If ye weight of ye Atm.re were to be employed as ye actg power for all ye Regulators cd be easily opened & shut by ye then existg Contrivances & ye Air Pump Rod cd be suspended from ye workg Beam

If however ye Engine was wanted to receive all ye advantages of ye Invention ye Cylinder was to be placed in a Case, containg Steam with access for that Fluid to ye upper side of ye Piston, so that it might act upon it as the Atm.re acted in common Engines or in ye case just stated.

Or in this latter manner were ye Engines made wch he constructed in ye beginng of ye Business, that is to say, The Cylinders were fixed in a Case containg Steam with wch Fluid they were wholly surrounded & their Mouths being open within ye case, the steam had always access to ye upper side of ye Piston, & was admitted to ye part below ye Piston, only when ye Piston was rising. The openg from ye Cylinder into ye Eduction Pipe was shut by a valve, while ye Piston was risg, but when it was required to descend, ye valve was opened; these valves were of the slidg kind used in Newcomen's Engines. The Ejection was made into ye Eduction Pipe, & ye Air Pumps, wch drew out ye Water as well as ye Air, were fixed to ye bottom of ye Eduction Pipe, wch had a Valve to prevent regress as usual. There were sometimes one Pump, & sometimes 2 or 3, as circumstances or ye Fancy of ye Momt directed. The workg beams & workg Gear were made in ye usual manner or nearly so, & in cases where there were Boilers fixed for ye common Engine, it was supposed they were used without alteration.

These Engines then differed in nothing from ye ancient ones except in ye application of Mr Watt's Principles as set forth in his Specification.

It was found that ye external Cylinder or Steam case was very expensive. The method of coverg ye Cylinder itself, with a Lid or Cover (wch had been used in some of ye Models) & conveying ye Steam to ye lower end of ye Cylinder by a Pipe was adopted, & a less expensive Method of applying ye Envelope of Steam was used, other kinds of Regulations were invented, & the whole Mechanism of ye Engine was gradually improved, & ye Improvements have been progressive for these last 21 years, Some of them Mr Watt has secured by other Patents, but many of ye more essential he has left free, & by means of them Newcomen's Engines have been improved to his loss.

It will now is it hoped appear to ye Candid that Mr. W. has not wilfully concealed his Invention by a false Specification, but has set forth the nature of the same & means of performing it. He has told what he had Invented & it cd not be expected that he shd have described Mechanism already known to all Practitioners or not then invented.

Mr. W's Invention is merely a contrivance to prevent cooling the Cylinders & to make ye Vacuum more perfect, by condensing ye Steam in a Vessel distinct from ye Cylinder itself. This is the essence of the Invention, the means of keeping ye Cylinder warm, The substitution of ye power of Steam for those of ye Atmre., of Grease &c. in place of water to keep ye Piston tight, & ye drawing out ye Air &c. by means of Pumps, are merely Aids in performing ye principal Object.

This ought to be kept in view in judging of the Specification; also that Mr. W. supposed it to be addressed to Mechanics & Philosophers & not to ye Ignorant.

Objections considered

Bull Objects: that Mr. W. says, he condenses ye Steam by ye Cold of ye Condenser by ye application of Water or other cold Bodies, but does not add, that he injects any Water into ye Condenser to condense ye Steam. In fact, Mr. W. directs that ~~the~~ Vessels shall be distinct from ye Steam vessels themselves & that these condensing Vessels shall be always kept as cold as ye Atmre. by ye application of Water & other cold Bodies.

This evidently refers to ye Common practice of an Injection, but it is also fact, that ye Steam may be condensed by ye external application of water to ye condensers tho' not so expeditiously unless ye surface of ye Condenser be much extended, as Mr. W. has found by many Experiments, but if sufficient time be allowed, ye Steam will be condensed even by a small surface, if kept always cold by a Stream of Water. & some advantages wd attend this practice: for, then, no other Water wd be required to be extracted by ye Pump than that quantity of wch ye steam was composed. The Injection was well known to every body, who knew ye Steam Engine, & if you had told ye most Ignorant Tender of ye old Mechanic to condense ye Steam (had he understood ye word) he wd have opened ye Injection cock. Mr. W's silence therefore implies that it was to be done by ye common means unless ye Engineer himself knew of a better.

When ye Pump is pointed out for ye purpose of drawing out ye Air & other Elastic Vapr. it seems ridiculous to object it is not mentioned that it was also to draw off ye Water, such being ye more General Use of a Pump & obvious to every understanding.

Hornblower's Objects; that ye size & Method of applying ye Condenser were not specified. The Nature of those vessels do not admit of any determinate proportion to ye Cylinder, at least such proportion is still unknown to Mr. W. The Condenser will to every thinking Engineer appear to require to be large enough to hold all ye Injection water, with some space to contain the rarified Air wch has entered with ye water or with ye Steam. It was well known before Mr. W's Invention that ye Air contained in common water is abt ye 30th part of its Bulk, consequently space must be provided for that, & its Rarefaction by ye degree of Vacuum required; as to ye Air entering with ye steam, it is so minute a quantity as not to deserve notice. That wch comes in by ye Air Leaks depends upon the perfection of ye workmanship & is consequently incalculable & there be very little if ye Engine is good.

The same reasons applies to ye Air Pump. To those who will take the trouble of calculation it will appear that an oversize in those vessels is not hurtfull, that have been in practice made of various sizes, all with good effect & in ye very first trials Mr. W. succeeded merely by following ye dictates of common sense. He knew that no provision was necessary, & cd not suppose it wd be demanded.

As to ye form of ye Condenser it is perfectly immaterial, a Globe or a cube will do, a Cylindric or tubular form has been in general adopted, as more convenient to be cast by the Founder or made by the Coppersmith & in some degree from a kind of deference to ye ancient forms of ye parts of steam Engines. The forms of Pumps are well known & that their working part must be made of some figure of equal dimensions from end to end, whether its area be circular or polygonal & it is to be remembered that any kind or species of Pump answers the purpose. The forcing Pum & even an Iron Bellows have been used by some of the Pirates, ye common lifting pump has generally been used by Mr. Watt.

The manner of working a Pump from ye working beam of a Steam Engine was surely matter unnecessary to be explained by more words & it seems a disgrace to ye profession that any person calling himself an Engineer shd complain of such want of precision.

In respect to ye means of forming a communication between ye Cylinders & Condensers wch Mr. W. certainly thought sufficiently obvious all ye communications with ye Cylinder in Newcomen's Engines were made thro' or near ye bottom of ye Cylinder, there ye steam & injection water entered & there ye eduction pipes had their origin & there Mr. W. made his openings for admitting & drawing out ye steam but had this question not admitted of this answer, it admits of another wch is, that it may be drawn out at ye upper end of ye Cylinder if that end is shut & performs ye office of ye bottom as in Mr. Watt's invented Models & in Bull's Engines: the absurdity of making openings in any part of the Cylinder where ye Piston slides thro' must appear too glaring for even a Tyro in Mechanics, to attempt it. as to ye form of ye passage it may be square round or angular at pleasure, & it has been already said that a common sliding valve wd answer as well to open & shutt it, as it did in ye ancient Engines. *

The Specification saying, that in many cases ye Elastic force of Steam was intended to be applied to act upon ye Pistons in ye same manner as ye pressure of ye Atmre. was then employed, meant that in most cases that was to be done, & indeed there cd be no argumt. against it in all cases, except additional expence wch according to Mr. W's Scotch Ideas appeared a greater object than it does to an English Tradesman. This Maxim was not stated positively because it was not an absolute Condition, a sine quâ non; very good Engines may be made without it, hence ye word "Intend" wch was used from mistaking ye nature of the Specification, & alluding to Engines to be constructed in future. for it is a fact that in ye Models of Mr. W. made before he obtained ye Patt. he used ye said force of Steam generally & seldom ye pressure of ye Atmre.

Hornblower asserts contrary to his better knowledge, that it is impossible to apply Steam to ye Piston in ye manner described; If his Ingenuity or Knowledge did not extend to ye confining ye Steam by a Cover on ye Cylinder, or by placing ye Cylinder in a vessel full of Steam, he might if he had been inclined to do ye thing, have placed ye Cylinder within ye Boiler where Steam had been usually confined & it wd have answd. as it has been proved in some small Engines †

To finish ye objections wch relate to ye essential parts of ye Specification wch are in question in ye presnt case, I come to ye last Article vizt. the substitutes for water to keep the Piston & other parts of ye Engines tight.

The first substance Mr. W. had recourse to, was Wax wch answers indisputably well, & there is no objection to it, but Price; Oils also answer very well tho' some of them suffer Chemical Decomposition wch Mr. W. was not then aware of, but wch wd not preclude their use if better ones were wanting. The fat of Animals is the Substance generally used at this time.

Tar, wch is a Resinous Body, is also occasionally used, & common Rosin might be used, as it melts in boiling water, & has then a lubricating quality. Quicksilver as a fluid impermeable to Air might be used, were it cheaper, & if all ye parts with wch it was brought into contact were made of Iron, it wd not injure them as every body knows who knows ye nature of ye substance. It has been applied to many Pistons

† It seems strange however that persons accustomed to Steam & used to confine it in Boilers, Cylinders Steam Pipes &c. Could be at any loss how to confine it above ye Piston. Such ignorance must be affected & wilfull

* In applying ye Pump to ye Condenser to draw out Air, & it may be applied to every part, & if it is wanted to draw out ye water, scarce any person except the ingenious witnesses wd have required to be told that it must be applied to ye place where ye water was to be found vizt. at ye bottom or lower part of ye condenser.

of Pumps tight & to lessen Friction, by Sir S. Morland in ye last Century (see his Quicksilver Pump in Desaguliers & other writers) A Mixture of Lead Tin & Bismuth was published by Sir I. Newton or his disciples wch melts in boiling water & was commonly known under ye name of Newton's Metal, long before Mr. Watt's Invention; this wd also answer ye purpose of preventing ye passage of Air & Steam tho' it might be attended with some inconvenience & expence.

There is an observation to be made here, upon wch the Objections are silent, it is, that these substances are said not only to be for ye purpose of keeping the Pistons tight, but also other parts of ye Engines, meaning moving parts, & some of these substances, tho' less proper in the Pistons, may be so in other places. Mr. W. might shelter himself under ye superflua non nocent, were that Rule extendible to an Engine, but ye fact is this, he tried ye substances mentioned, & found they do in a better or worse degree, & he inserted them in ye Specification, lest Pirates shd use them & thereby defeat his patt. It is agreed on all hands that Grease Tallow & Oil answer ye end, & having found that it was needless to have recourse to other expedients in common Practice, there was no intent to deceive, & it cannot be supposed that ye short & furtive Experiments of an Inventor, not secured by Patent, cd pt. out all ye possible Chemical Contingencies wch might happen to such substances, in continued use.

As to ye Objections to ye 5th Article of ye Specification, Mr. W. asserts & hopes to prove, that ye variety of his Invention there described, is in ye first place, intelligible & 2dly that it has been made & used with Effect. It was found however, that ye presnt mode of producing rotative motions from reciprocating Engines was less expensive & in several respects preferable, therefore ye other was abandoned.

As to ye 6th Art. concerning wch such impudt. assertions have been made. It has never been executed in great; yet, it is practicable, tho' it may not be preferable. It is well known that steam like Air, admits of Expansion by heat & assumes a great bulk. If then Steam of 300° of Heat were to fill a steam vessel & then were drawn into a condenser of 212° of heat, or that of Boiling water it wd not be condensed into water tho' it wd become less bulky, consequently a certain degree of exhaustion wd be made in ye Cylinder & ye External Steam wd act upon ye Piston with a certain force. In ye same (manner) if Steam of 212° were to be drawn into a Condenser of 180° containing Steam of ½ the usual density its Elastic force wd be lessened but it wd not be condensed to water. If however Mr. W. has been deceived & his Principle shd be thought either impracticable or erroneous, it ought not to invalidate ye remainder of ye Specificn. as it stands perfectly distinct from it & is introduced only as a Modification & as nobody has infringed in that way it is not now in Question.

On ye whole of ye Specification, it is to be observed, that Mr. Watt's Invention being applicable to an infinite variety of forms of Steam Engines, had little or nothing to do with ye Mechanism thereof.

The forms & Situations of ye parts allowing of great variety as is sufficiently proved by Mr. W's own Application of the Invention & by ye forms of the Pirates Engines wch in ye ingenious Mr. Flint's words resemble each other little more than an egg does an Oyster. & Mr. W. having at ye time of ye Patent contrived no better Mechanism than was then in use in ye Common Engine, he was advised to ye kind of Specification he made, wch if faulty in pt. of Language or Expression, shd be in some degree excused by his then comparative ignorance of ye English Language, & even of Literary Composition. He must however still insist, that the method by him invented is intelligibly set forth without disguise. If some men do not understand it, it may be that nature has denied them parts or attention, or that their Ideas have run on other directions. He is also persuaded that it is sufficient to enable an Instructed Mechanic to execute ye Invention; perhaps as one person of Eminence observed in a superior manner to Mr. Watt himself. To say that a specification must be sufficient to enable such person to execute it well, without thought Invention or trial is exacting an impossibility. Mr. W. cannot now write such a Specification, & had he wrote one more detailed he wd have probably more confounded than instructed his readers. The multiplicity of words & of form frequently misleads ye Understanding.

There are specifications in ye Office (Stanhope) so much detailed & so long, that to read them once, or oftener, even with Attention by no means gives clear Ideas of the thing intended. Mr. W. speaks for himself; but he has in such cases found it ye easiest way to find out the scope of ye Invention & then to consider ye means by wch it may be effected in his own Mind; before he studies the Author's particular description: & when he has so done, it frequently appears that ye Authors' means are not the best he might have employed. Other Men may possibly make ye same Observation on some of ye Specification for Mechanical Improvements on wch Mr. W. exerted all his Powers of Description & spared no labour.

To say that no Experimt. shd be necessary is asking too much from any description of a Complicated Machine, or nice Chemical Process. The thing is in itself impossible – who can teach by words or Drawings any man to paint like Sir Joshua Reynolds? & there is a Tact a certain undescribable sense or feeling necessary in Mechanics as well as in painting.

Mr. W. has seen & examined a Specification of Mr. Bramah's patt. Lock, wch he thinks he understands (Repertory septr. 1796 No. 28) tho' he wd probably have understood it as well, & sooner without ye calculations & other superfluous verbiage with wch it is confounded & perplexed, yet he is free to say that he cd not thereby make a Lock equal to those made by Mr. Bramah, without some abortive trials & experiments, if he cd at all with his own hands; nor does Mr. W. think a professed workman could.

Plenty of other examples might be adduced. An Engineer must think, he must calculate & he must Invent even in ye common Machines & other matters of his Business in every Case he has not already practised * (Engineer ab excogitando Ingenium)

Note. Mr. W. has lately contrived an Apparatus for procuring factitious Airs for Medicinal Use. He published a detailed Description of the Apparatus & of ye Processes, accompanied with Plates, & moreover he prevailed on Boulton & Watt to make ye Apparatus for those who required it. So that ye using ye Apparatus was all ye Apothecary had to attend to: Mr. W. wrote con amore & now sufficiently aware of ye difficulty of conveying information by words & Drawings, he was at all ye pains he cd. to explain even Minutia. Yet he has had ye misfortune not to be understood by many, the strangest blunders have been committed, & he has been obliged to write again & again other Directions & after all, he believes insufficient, for those who do not think, or have not ye necessary previous knowledge.

One thing may have misled many; wch is the looking at Engines constructed now by Mr. W., & finding in ye Specification no description of the Mechanism thereof. That Mechanism so far as it differs from Newcomen's, has been ye Fruit of ye Inventive Faculties of himself & other Ingenious men for 20 years. At ye time of obtaining ye Patent, it was not invented, it did not exist. But all ye essential Parts of Mr. W's Method did exist & are exhibited in ye Specification. No Law can be so unjust as to punish him for not describing what was not invented nor intended to be protected by the Patent.

What has been said, will acct., it is hoped, for there being no drawings to ye Specification. Drawings can only exhibit particular forms & dispositions, to none of wch Mr. W. cd tie himself down without manifest detrimt. in an Invention. The application of wch were so general & admitting of so many varieties. He was informed, however erroneously, that variations of form might elude ye Specification & that it had been so determined in ye Courts of Law. he is happy to find now that ye most Respectable Judges think otherwise.

The Preamble of ye Act of Parliamt. is brought in to prove that he had still Experiments & Improvements to make. Granted. But what were they? Not upon ye Method described in ye Specification but upon ye Mechanism of ye Engines wch was defective upon making perfect Cylinders. Air. Pumps Regulators valves &c. All wch still admit of Improvemt. & long may do. †

He had a more arduous Task still, wch was to train Workmen to execute the parts; wch is not yet perfectly accomplished. Mr. W. does not pretend to answer for the Inaccuracy in ye Title & Preamble of ye Act of Parliamt. these were the work of the Clerks or imposed upon him.

† Nor does the Act recite it was upon ye Invention but "upon those large & complex Machines"

8/ in the Committee with whom he cd not dispute if he had been fully aware of the extent of the Impropriety. ⊕

4 ⊕ The inference wch Hornblower draws from the trials is intirely Erroneous. The object of ye Specification viz. saving ye Consumption of Steam & Fuel was fully obtained in ye first trial where ye Ideas were practised. But ye desire of presenting to ye World ye Fire Engine not only improved in its principles but also in its Mechanical Construction, induced him to employ many years of thought labour & expence in perfectg the Valves Gear & other parts of its Mechanism. These are the Trials mentioned in ye Petition to ye House of Commons as Grounds for ye Compensation asked from them. They were then thought very distinct & sufficient Claims to their favor wch was shewn by their prolonging ye Patent of ye original Invention & surely therefore ye Improvements wch were considered by that Honble House as additional Titles to Reward, cannot with Justice be admitted as a Plea for Invalidatg his prior Specification. The public has been benefited by these subseqt Improvements not only by their application to ye Engines made upon Mr W's principles but also by their Introduction into ye Common Engine & various other Machines. The Ingenuity displayed in ye construction of the Engine is a merit intirely distinct from ye Original Object of ye Patent & it has accordingly been separately Rewarded.

The Accusations of Plagiarism are next to be considered

1st It is said the Invention was made by Dr Roebuck meang probably Dr Roebuck of Borrowstone. The Invention was made before Mr W. knew this gentleman, & Mr W. wantg support in Money Matters to carry on ye Invention, applied to him for that purpose, & agreed to allow him a certain share of the Profits upon certain Conditions, but Dr Roebuck to Mr Watt's knowledge or belief never Invented any part of ye said Method of savg Steam & Fuel. At another period Dr Roebuck's affairs not permittg him to afford ye necessary supplies he assigned all his Claim upon ye Invention to Mr Boulton & this is the whole of his Agency in it. Dr Roebuck's eldest son signs as a witness to ye Specification.

Steam was never used to press upon a piston as an actg power in any Steam Engine, that Mr W. knows of: before his Invention Savary's & Papin's Application of it have been explained

Grease & Oil were some times used & some times soap to lubricate the Pistons of Newcomen's Engines, but always in Conjunction with water, & never as Mr Watt believes or has been credibly informed, for ye purpose of keepg the Piston Air Tight

The Cylinders never were surrounded by any thing that Mr W. knows of, until Joseph Heath took a patt in 1768 for surroundg them with Cold water (This man was Coal overseer to Dr Roebuck & probably had by some treachery seen some of Mr W's Models & mistook ye use of ye Steam case)

The Application of Pumps to Extract ye Air was equally unknown & in ye old Engines unnecessary. Mr Wood's project on that head has been explained to relate to an Engine workg by means of heated Air & by its alternate Expansion & Contraction.

The Condensg ye Steam in a separate Vessel, there is not ye least reason to believe ever existed before Mr W's Invention.

To Mr Bramah's learned Declamation Mr W. will only answer that he has never claimed any thing under his Patt but what is contained in his Specification, otherwise he might have claimed Mr Bramah's water closet accordg to Mr Bramah's own rule.

Grantg that none of these separate Articles were new. Still the combination must appear to be so. The condensation in a distinct Vessel cd be of no use without ye Air Pump or some similar Contrivance: for were ye Air & Water to be blown out of ye Condenser by Steam in ye old way, ye Evil of destruction of steam wd be Augmented instead of Remedied.

Were ye Air Pump applied to an Engine with Injection into ye Cylinder & water upon ye Piston ye Engine wd be no ways mended.

Were Steam to be used as ye actg power on ye Piston, in ye last Case, ye advantage wd be small if any, & ye keepg ye Cylinder hot wd do harm, because it wd occasion a greater quantity of Injection water to be used

Some small advantage might possibly be derived from usg Grease on ye Piston, but as ye water wch enters that way serves as so much Injection water, it seems that ye latter wd be increased, if ye former were diminished, something however wd be gained in pt of friction.

Cylinders Pumps & working Beams, Boilers &c. are all old Inventions, yet ye use of them is not alledged to weaken ye Specification.

Then supposg ye Action upon ye Piston by Steam, ye keepg ye Cylinder hot. The Condensation in a separate Vessel ye Air Pump & ye application of Grease to ye Piston to have been all of them separately used prior to Mr W's Invention, they cd not fail of being useless or hurtful, but if they had been separately useful, that does not lessen ye Merit of ye Combination of any two or more of them, nor detract from it as a new & useful Improvemt. Had they been used in Combination, such use wd have manifested its emint utility & wd not have been laid aside, nor wd any man have been found of such singular Modesty, as to be silent 27 years while ye Merit & Profits of ye Invention were assumed by another.

No such Invention has however ever existed, nor were even ye principles used separately except in ye Brains of those ingenious Gentlemen Jonathan Hornblower & his associates, on whom it seems incumbt to prove by Facts instead of Hearsays & Beliefs that those principles have been used not only separately but conjointly before ye date of Mr W's Patt; & it wd further seem necessary that they were used usefully & publicly, private or infructuous uses cannot serve their purpose & perhaps to obtain Belief, witnesses may be required whose hands are clean & who have not themselves been guilty of piracy.

Not one word of all these prior Inventions was heard of until abt 1780 when Mr W's Invention was found to be useful & Hornblower Junior had commenced his Piracy, & then, as far as Mr Watt remembers ye Murmurs were confined to ye Grease, & Hornblower or most of his Family gave their Opinions very freely against the Engine, even after they had seen it, & had its Construction explained, some even, after it was at work.

Captain Trevithick even to this hour, or at least very lately maintained that Newcomen's Engines made by John Budge were better.

Onec of ye Clauses

Another Clause

2/ Winsor ... J. A. De Luc (I suppose) to Mr Watt 9

Dr Sir Mr Rous did me great honr in expressg his wish of havg my opinion on what he has written in ye Cause; he is such Master of it, that with his abilities & knowledge in ye Law affairs, he cd not have a better adviser than himself. However, after havg read his Memorial, seeing what was the new Question, I wished to know every thing that might relate to it, & I desired Mr Weston to procure me, those necessary documents. He sent me a Bundle of Papers wch almost frightened me: I shall only copy his Catalogue.

1st A Copy of ye Act of Parliamt. 21 Jac. 1. c.3 2d Ld Coke's Commentary on that Act.

3d Mr Justice Buller Rules, concerng specifications; with observations on those Rules.

4th Copy of the short hand writer's Notes of what was said in ye Court when ye new Question was started in ye Cause.

5th Copy of Mr Dollond's Specification.

After havg read attentively all those Papers, I found myself more & more involved in a Labyrinth & I was ready to give up the task, as not being bred up for the Bar.

However, after havg dropt ye subject for 24h. retaining only of ye disagreeableness of Cavillation the wish that they might be avoided, I took separately that part of ye Act against Monopolies, wch, by an exception, determines the case in wch Patents may be granted;

A Patent (Mr Dollond's) to see at ye source, what a specification is to be: & ye Discussion in ye Court, as taken down by ye short hand writer: Then comparg the last of those Documents, with ye 2 others, I gave course to my thoughts, in order to form a judgemt for myself: & by degrees it appeared to me that all ye difficulties vanished.

In putting down my thoughts I have not attempted to weave with them many useful particulars, wch are in Mr Rous's Memorial; there being at prest no necessity to introduce them, in ye bustle of my odd English; as I have only undertaken to explain what I think now in general on ye subject, wch before, had puzzled me very much.

Argand's Law suit made me first acquainted with it: there, I saw ye private interest of ye number rise eagerly & by all sorts of means against ye rights of the few; I saw a system against Patents, supposed to be for ye good of ye Public, tho' it appeared to me very much ye reverse: & as no Law was ever mentioned, I thought, that every thing was left to ye opinion of Judges. ~~I saw afterwards~~ prejudiced against Patents.

I saw you afterward & with great concern, involved in that Labyrinth of Opinions: & after I had heard what passed in ye House of Commons; it appeared to me, that ye Common sense of ye public cd only save you; ye publishing of an exposition of ye Case. Some being prepossessed by those ideas.

The Question left behind by ye Ld Chief Justice did not astonish me; since I thought there was no other rule for the direction of such trials than ye opinion of ye Judges: & I might have retained that Idea, if Mr Rous had not expressed his wish of havg my opinion on his Memorial. This made me ask, for all what ye Law stated on Patents: wch was sent me by Mr Weston with Commentaries; & in these, I found all ye mischief. The Law itself, appears to me as clear as possible for ye direction as refers cleverly every possible Question on Patents: the opinion of Men of proper knowledge & the verdict of a Jury, without any Question of Law; fixing as precisely as possible, on what pt there may be a Question to be decided in that manner.

Such is ye pt of view in wch I have considered the object, with intention to state a general principle, wch appears to me of ye greatest evidence. I have done it in a Public spirit after long consideration on the general subject, happy to find that ye case illustrates it completely. How far I have succeeded, you will judge her from black & white.

But if you think it worth communicatg to Mr Rous pray inform him at ye same time, of ye rambles of my mind; that, in case I have gone astray, he does not pass a severer sentence upon me, than upon a Merry-Andrew when he crawls under ye table, in imitation of the Tumbler who flies over it.

Remarks on Mr Watt's Specification of his Steam Engine

There cannot be any Legal Rule in this Cause, than ye Clauses of ye Act wch authorises ye grant of Patents & ye Conditions prescribed in the Patent granted; to those Rules I shall then confine myself; since when ye Law speaks Opinion must be silent.

One of ye Clauses prescribed in ye Act, is this" That ye Manufacture be new, & that ye Patentee be ye True & first Inventor of it"

This, is a clear Rule wch requires no Commentary: it is certain also, that if there is any doubt on its execution, the Case must be decided from Evidence. A Question arose on that pt in Mr W's case, & it was decided by ye Jury's verdict.

" That the whole of what ye Specification expresses to be Invention of Mr W. was really invented by him"

Another Clause of ye same Act is; "That ye Invention shall not be mischievous to ye state"

This pt also is decided: for ye Ld Chief Justice declared in ye Court, from public notoriety; "that this was a very noble Improvemt in ye

" Fire Engine, for wch ye Inventor deserved ye thanks of ye Public, & all sort of Protection as far as ye Law will or can protect them"

Those, are ye only Clauses of ye Act against Monopolies wch interfered in ye Cause; it was decided that they had been complyed with by the Patentees;

3 10

& in consequence they found themselves under ye Protection of ye Law. For the Cause had been brought before ye Court by ye Patentees as Plaintifs, against an Invasion made on their Patent. The Defendant, Mr. Dast Bull, pretended that his Engine was not that of Mr. Watt. On that pt. also, Evidences were heard, & ye Jury pronounced in his Verdict.

"That Dast Bull's Engine, was a manifest Piracy of Mr. Watt's Invention"

In summs up ye Evidence on that pt. Ld. Chief Justice Eyre, explained by Evidence " That ye having turned ye Engine upside down, was a subterfuge; wh. upon ye Evidence & upon ye nature of ye thing, made no sort of alteration with respect to ye operation of ye new discovered Principles; they being used exactly in ye same manner to all substantial purposes"

That statemt. of ye Ld. Chief Justice spread light on ye new Question wh. remained undecided in ye Court.

Mr. Watt's Improvements, are thus declared, as they are in fact new discovered Principles in respect of ye Modifications of Steam; wh. Principle may be applyed under various circumstances, & answer however in ye same manner, ye undecided same substantial purpose: & that a decision of that nature depends on Evidence.

Proceedg now towards ye new Question wh. ye Defendant is authorised to bring into ye Court; we have no more to consider in any respect ye Act against Monopolies; For, that Act relates to ye Cause, only with respect of ye Novelty & novelty usefulness of the Invention & of ye real Inventor: wh. pt. havg been decided by ye Court, as well as that of ye essential Identity of ye Defendant's & of Mr. Watt's Engines, cannot be put again in Question, but by appeal to a superior Court.

There was another Legal Rule between the Parties, namely ye Conditions prescribed to ye Patentee when he receives his Patent & that Rule ~~shall cause a description~~ of (as stated in Mr. Dollond's specification whence I have taken it is: that

"The Patentee shall cause a description of the nature of his Invention & how the same is to be performed, to be inrolled in Hs. My's. High Court of Chancery"

This now is undoubtedly ye only Law that we can have in view, & to it, I shall refer all my further remarks.

The immediate (& I shd. think ye only) pt. of Fact to be decided in Mr. Watt's case, is also Res judicata. The Defender attempted to prove, that Mr. Watt's specification was not sufficient: Evidences were heard on both sides, & ye Jury gave his verdict

"That the Specification sufficiently explains the Invention of Mr. Watt to enable an Artist reasonably skilled in ye Fire Engine, to construct one on his Principles"

Thus ye immediate pt. of fact is also decided; Mr. Watt's explains sufficiently his Invention, for a skilled Artist to execute it

But there remains a general Question, wh. Ld. Chief Justice Eyre stated as follows

"Whether the particular Instrumt. must not be organised, & described as organised?" " wh. Question" (adds his Ld.ship) "has not been very distinctly mooted as a Question of Law; & it is a Question wh., if upon consideration, the Parties desire to have the further opinion of ye Court upon, I think they ought to have it"

Therefore, it may happen, tho' not very probably, that ye Defendant requires to have a Special verdict on that Question.

Here, as already shown, there cannot be any other Legal Rule, than ye Condition of ye Patent; wh. is: to deliver a Description of the nature of the Invention & how ye same is to be performed; in wh. there is no injunction to the Patentee to describe his Invention as organised; an injunction, even repugnant to ye idea of a general Rule, wh. accords to Mr. Rous's very just observation, is as applicable to invented Colours, Medecines or other Chemical products, in wh. no organisation can be considered as to Inventions or Machineries.

Therefore the application of that Clause must depend on ye Nature of the Invention: & whether it has been complyed with in a particular case, becomes a Question, not of Law, but of fact; dependant on the Evidence of Men of Knowledge in that particular object.

There is no doubt that when the Invention relates to any Machine, it must be described as organised; but at ye same time, it is necessarily so, & cd. not be otherwise; since a Specification relatg to a Machine must either describe certain parts of wh. it is composed, if wholly new, or refer to a known Organized Machine, & to some particular parts of it, if ye Invention is only an Improvemt. Therefore, every Invention concerng a Machine, is always described as organised & ye only Question that may arise in that respect is; whether it is sufficiently so.

From ye tenour of ye condition prescribed to ye Patentee, he is at liberty to give ye Description of his Invention concerng a Machine, either in a Drawing, or by a Model, or in words; for, nothing is prescribed to him in that respect

I do not know, if human wisdom cd. devise some Conditions of Patents more conducive to ye necessary union, of ye public good, with ye safety of the Man of genius whose inventions do good to ye Public; than ye conditions now existg; but this everybody must know, that no body has a right to place his wisdom in competition with ye Law on ye subject.

Here, the Law prescribes nothing further to ye Patentee, than that he, shall describe the nature of his Invention, & how it is to be performed; & whether he has accomplished, that condition must rest on the Evidence of men intitled to be consulted, from their knowledge on ye subject.

On a general Question of that kind, with respect to Machines, it wd. immediately occur to men conversant in Mechanics & in Experimental Philosophy, that there are Machines in wh. nothing but mechanical powers & known materials are used, & other in wh. physical causes interfere: distinction wh. must produce some difference in ye obligation of the Patentee tho' expressed in ye same words in every Patent.

I leave aside ye first case, as foreign to our subject; but as on ye 2d., I cannot have a doubt that the same Man wh. decide: that, as there is no assignable to the attainmt. of knowledge both on the nature of physical causes, & on ye manner of applying them to ye best advantage, it wd. be unreasonable & detrimental to ye Public, to impose on ye Inventor ye condition of describg ye precise manner in wh. he shall execute, during ye whole time of his Privilege, ye new principle or method that he has discovered

When a Man of genius & of previous Knowledge in Experimental Philosophy has discovered, that some physical cause may be turned into use, or to better use, in some Machine, & that after the necessary experiments with a workg model he has ascertained sufficiently, the expected effect, as to think of takeing a Patent; if he were obliged by a formal Clause to deliver that Model, or such a specification describg all its parts, precisely as they are acting, or acted upon: such a specification wd. then be ye only standard of his right of Invention durg his Patent. But this also wd. fix on him alone ye right of practisg in ye only manner wh. can extend ye knowledge, wh. is ye bringg his Invention into use: he then alone cd. discover those deffects or Improvements wh. can only result from practice; but he wd. take care not to bring his new discoveries into execution; since then his Machine not being ye identical one, on wh. he had given ye Description, it might be imitated without infringing his Patent. Therefore an ingenious Inventor wd. keep his new discovery to himself, wh. wd. be a first loss to ye Public: & at ye expiration of ye Privilege, he wd. take a new Patent, for those Improvements, on his first Improvemt.: & thus protract ye free enjoymt. of ye Public. This, is another consideration that Mr. Rous has strongly presented in his Remarks.

But that inconsiderate Rule does not exist; the Patentee is only bound to give a description of the nature of his Invention & how ye same is to be performed: wh. Law being general & applicable to every case of Invention leaves necessarily its execution in particular Cases to ye Evidence of Experts.

Let us now examine how Mr. Watt has conformed himself to that condition, wh. was his Rule, & is ye only Rule on wh. he can lawfully be tried.

Since ye object of his Improvemt. was a Machine, he was undoubtedly to express or refer to his specification: & so he did: for, his Improvemt. was on the common Fire Engine a Machine well known; therefore, if he had described it, a confusion might have arisen, between what was his Invention & what was already known, wh. had helped ye cavillation of Invaders.

Havg thus Indicated clearly ye Machine wh. he intended to improve, he was to describe ye nature of his Invention & he did it, by declarg that it was for a Method of lessenng ye Consumption of steam & fewel. He did not pretend to determine what wd. be ye quantity of that saving: for, from ye nature of the thing, well known to Experimental Philosopher, he cd. not ascertain it, but by an open & general practice: & he cd. not proceed to it with any hope of advantage, considerg ye great expenses of such an attempt before havg secured to himself for a time, by means of a Patent ye sole execution of his discovery.

After that step only it was that, as well as from ye expression of ye Law, Experience cd. determine, at his own risk, & cost, & without any detrimt. to ye Public, what wd. be his private reward, & ye advantage that the Public was to expect from his Invention as far as he cd. think it possible under ye protection of his Patent.

From that certain nature of the object after havg declared ye nature of his Invention Mr. Watt was only bound by his Patent, ye sole Law in ye object, to describe, as far as cd. be done, without foretellg what cd. not be seen how his Invention was to be performed.

This also he described as organised; since, he referred to known parts & known practices in the common Fire Engine, indicatg how they were to be altered, for ye declared purpose of lessenng ye Consumption of steam & fuel

The followg is the manner in wh. he described his Method for that purpose.

"The Vessel in wh. ye Powers of Steam are to be employed, wh. Vessel is called ye Cylinder in common Fire Engines, must, during ye whole time ye Engine is at work, be kept as hot as the steam that enters it. — In Engines that are to be worked wholly or partially by condensation of steam, this, is to be condensed in vessels in vessels distinct from the steam vessel or Cylinder. — wh. Condensers ought at least to be as cold as ye Air in ye Neighbourhood of ye Engine. — Whatever Air or elastick vapour is not condensed by ye cold of ye Condenser ... is to be drawn out by means of Pump. — I intend in many cases, to employ ye expansive force of Steam to press on ye Pistons, in ye same manner, as ye pressure of ye Atmre. is now employed in common Fire Engine. — Instead of using water to render ye Piston or other Parts of ye Engine Air & Steam tight, I will employ, oil, wax, resinous bodies, fat of animals, Quicksilver &c."

Such is Mr. Watt's specification; & on ye Evidence produced in ye Court it has been declared by ye Jury's verdict:

"That, it sufficiently explains his Invention, to enable an Artist reasonably skilled in the Fire Engine, to construct one on his Principles"

Therefore, was that to be tried again, (wh. I hardly can conceive to be possible) it wd. only be now, as a Question, to ye following import.

"Whether there is some essential part of Mr. Watt's Invention or of ye manner of performg it, that has not be disclosed in ye Specification"

Wh. Question is full as much as any of ye former, dependant on ye Evidence of Men of Knowledge in that branch of Experimental Philosophy; & there cannot be any doubt of their decision; for, every man well informed will acknowledge, that in whatsoever manner those directions cd. be litterally executed, there wd. be a great lessenng of ye consumption of steam & fuel.

Since then it is not possible to fail in accomplishing ye declared purpose of the Invention by executg any way what is prescribed in the Specification, wh. has already been pronounced to be within ye reach of every artist reasonably skilled in ye Fire Engine, ye condition of ye Patent is fully complyed with, moreover those prescriptions even in fact so precise, that notwitstandg many attempts to evade their expression, the Invader cd. not help fallg within their reach; because ye Principles are clearly expressed & their effect for lessenng ye consumption of steam & fuel are certain.

It is therefore evidt. in ye only sense of ye Law, namely by Fact, that Mr. Watt gave in his specification all ye descriptions that cd. in ye nature of ye thing, be given at that time.

By long practice applyed to public use, Mess. Boulton & Watt have executed those descriptions various ways all answerg to the same words of the specification, but in manners suitable to such variety of usefull purposes for the benefit of ye Country, that the Period of their Privilege will never be forgot neither in this Kingdom or elsewhere. It had been declared in ye Court, "that they deserve ye thanks of ye Public, & all sort of protection as far as ye Law can protect"

On their part, nothing has been wantg for ye accomplishmt. of what was prescribed by ye Law; therefore, they surely will have its protection, & tho' ye end of that remarkable Period, is rendered troublesome for them, by ye attempts of private interest will not be stained by its triumph; this, is to be ye more depended upon from ye followg precedt. perfectly in point.

Mr. John Dollond took a Patent. "for his Invention of a new new method of makg object glasses of refractg Telescopes by compoundg Mediums of differt. refractive qualities; whereby the error arising from ye differt. refrangibility of light, as well as those wh. are produced by ye spherical surfaces of ye glasses, are perfectly corrected"

This part, wh. is only declaratory of ye Nature of ye Invention for wh. he took a Patent; corresponds to Mr. Watt's declaration, that the nature of his Invention is a Method lessenng the consumption of steam & fuel in Fire Engine.

In obedience to ye Clause of every Patent, that, of declarg "How ye Invention is to be performed" Mr. Dollond proceeded also in ye same manner as Mr. Watt. The object was an Instrumt.; therefore an organisation was to be mentioned; but that Instrumt. namely, ye refractg Telescope being well known, he only referred to it, as did Mr. Watt, to ye known Fire Engine; after which proceedg to ye parts of ye indicated Instrumt. wh. was to be improved; as Mr. Watt specifyed ye Cylinder & various known practices in ye common Fire Engine, Mr. Dollond specifyed ye object glass in the common refractg Telescope.

Now, comes the indispensable distinction between a mere mechanical Machine, & a Machine acted upon by some Physical Cause. Mr. Dollond's Invention was that of turng to greater use the natural Modifications of Light; as that of Mr. Watt to turn to greater use ye natural modification of steam: in such case ye manner of execution rests on Principles of Experimental Philosophy, wh. principles are the ground work of execution in whatever shape it is performed: That ground work is then, what the Patentee is bound to declare accordg to ye nature of ye object: I have repeated above, ye manner in wh. Mr. Watt complyed to that Clause & followg is Mr. Dollond's.

"In these new Telescopes, the Images of objects, are formed by the difference between two contrary refractions: the object glass being a compound of two glasses put both together, whereof, one is concave & the other convex. The excess of Refraction by wh. the

"Image is formed, is in ye convex glass wch is made of a Medium or substance in wch ye difference of refrangibility is not so great
" as in the substance wch the concave is made of."

Such is ye only description given by Mr. Dollond of his new invented object glasses; a description sufficient for a Man of great Knowledge in the theory of Optics, to conceive; that it was to produce in some measure the desired effect; as an able Experimental Philosopher sees at once in Mr. Watt's Specification means of a great save of steam & Fuel.

But with respect to execution, those specifications are very differt.; & Mr. Dollond cd not have obtained from Evidence a verdict similar to that wch stands now in favr. of Mr. Watt

" That ye specification sufficiently explains ye Invention to enable an Optician reasonably skilled in ye Refracty Telescope
" to construct one on Mr. Dollond's Principles"

And ye diffce is even greater than it appears at first; for, tho' in treatg ye Question itself, I abstained mentioning so many Steam Engines of Mess. Boulton & Watt, wch are now employed all over ye Kingdom, those Engines exist, & they are compleat Models of every means of application, wch their long practice has suggested to them, ready to be immediately imitated by every Artist, reasonably skilled in Fire Engine: Whereas; had Mr. Dollond chosen to keep secret the manner in wch he succeeded best in ye execution of his Principle, the Telescopes he had made, wd not have directed a common Optician to imitate them; it wd have required the Knowledge of an able Chymist for discovery ye composition of ye 2 sorts of glasses he had used, & of an eminent optic-mathematician for determing from the refractive power of the obtained glasses the radii of their spherical form.

every Inventor, of a physico-mechanical Instrument, who cannot describe every particular of a new science before practice, has disclosed all ye form in wch his Method, founded on new Principles may be carryed into execution; & as a proof: after havg given a specification wherein he mentions the union of 2 glasses only: Mr. Dollond came in particular cases to combine 3, still on ye same principle for ye same expressed purpose.

Now, Mr. Dollond had also an Invader of his Patent, & he attacked him.

The Defendant first pleaded, that ye Invention was not new; & in some respect, it was not, at least in ye fundamental principle;

whereas Mr. Watt's Principles, as they are expressed in his Specification are absolutely new;

However, as Mr. Dollond had been first in bringing that Principle into a form for execution, the Defendant was condemned on that plea.

Then the Specification was attacked as insufficient; on ye ground, that a common Optician cd not have made Mr. Dollond's object glasses; with no other help than the specification.

But the Defendant had followed the Principle of Combing convex & concave surfaces of glasses different in their refractive powers, wch Principle was clearly expressed in the Specification & was the foundation of the whole.; for wch reason, Mr. Dollond came under the protection of the Law, & was maintained in the righ of his Patent.

Therefore, it is practically admitted in the Court of Justice; as it stands in the nature of things, to wch ye expression of the Clause in ye Patents is wisely adapted; that ye Principle of an Improvemt. for the better application of of a physical cause to a Machine, ye organisation of wch is known; is ye only requisite in a specification. even when ye common Knowledge of the Makers of that Machine is not sufficient for bringg. ye Principle into practice.

Therefore, & a fortiori Mr. Watt has accomplished the Clause of his Patent, since it has been decided on Evidence "That his Specification sufficiently explains his Invention to enable an Artist reasonably skilled
" in ye Fire-Engine to construct one on his Principles"

An if that Question were again brought into ye Court, under the form here examined, wch does not appear probable; there cannot be any doubt that Mess. Boulton & Watt wd after all their trouble, receive a final Protection of the Law.

1759

23 July

Copy of the Specification of the Rev.d Henry Wood

A View of the Objections w.h have been at various times urged against Mr. Watt's Specification

p. 3 Copy of Specification inrolled by Jonathan Hornblower

4 Answers of Mr. Watt to the Objections made to his Specification

6 Objections considered

9 Mr. De Luc to Mr. Watt

" D. - - - Remarks on Mr. W.s Specification

Notes relatives aux inventions de Watt en vue du perfectionnement des machines à vapeur

(à garder)

Windsor 2 aout 1811
Mr Deluc

D. Alex. Marcet
Russell Square
London

Windsor le 2 Août 1811

Nous ne vous avons oubliés, Monsieur, ni ma fille ni moi, quoiqu'il semblât que vous nous eussiez oublié; nous n'avons laissé passer aucune occasion de nous informer de vous, & auprès de personnes qui pourront vous l'avoir rapporté; mais dans une capitale &c. & avec votre profession, sans oublier ses amis, on peut être entraîné au silence.

Il est aussi un temps de la vie où l'on y est réduit, & je suis dans ce cas; fort avancé dans ma 85e année & très affoibli de corps, j'ai eu depuis 4 a 5 mois une plaie à une jambe qui m'a fait demeurer tout ce temps là confiné sur une chaise, sans pouvoir faire de mouvement qu'avec l'assistance de deux personnes; la jambe est mieux, mais je suis devenu toujours plus foible & moins disposé au travail, de sorte que j'ai abandonné toute correspondance excepté l'indispensable; mais je vous dois, Monsieur, ainsi qu'à Mess.rs Pictet & Prevost qui ont eu la bonté de vous donner des commissions pour moi, de vous parler des mêmes objets, en vous priant de leur communiquer ce que je vous en dirai lorsque vous aurez occasion de leur écrire, avec bien des amitiés de ma part.

J'ai appris avec beaucoup de plaisir que M. Pictet ait pris intérêt à mon analyse de la **Pile Galvanique**, & au nouvel instrument que j'en ai déduit, la **Colonne Electrique**, et le tout publiés dans le Journal de Nicholson; ce qui a renversé bien des erreurs sur les **agens chymiques**, & ouvert une nouvelle carrière en Physique & surtout en Météorologie; & je suis charmé que cela soit connu en France par la Bibl. britannique.

M. Pictet peut avoir vu que j'ai continué de m'occuper assidûment de la Geologie; il l'a pu voir dis-je, par les —

Elémens de Geologie que j'ai publiés à Paris; mais le malheureux état de l'Europe a interrompu pour la France & le Continent ce qui devoit suivre. Les propositions contenues dans cet Ouvrage élémentaire devoient être appuyées sur les faits repandus dans les relations de mes nombreux Voyages, ~~dont~~ que je n'ai pu encore faire passer en France; mais faites moi le plaisir de dire à M. Pictet, qu'il y en a déjà 3 Vol.s publiés chez Rivington, St Paul's Church yard à Londres; un de ces Vol. contient des Voyages sur quelques parties des ~~côtes~~ côtes de la Baltique & de la Mer du Nord, & les deux autres de Voyages en Angleterre. Il y en a de plus deux vol.s de Voyages en Allemagne & dans le Jura qui ne sont encore qu'en M.S. Quand tous ces Voyages seront publiés librement, la Geologie n'aura plus rien d'obscur. J'ai fait ressortir partout ce que cette Science doit à M. DeSaussure.

Je vous prie de dire à M. Prevôt, que je conçois en general qu'on peut abréger les calculs des hauteurs ~~ob~~ obtenues à l'aide du Barom. par quelque Table, ce qui est très-commode pour un voyageur. Mais après avoir fourni cette manière aisée de mesurer les hauteurs jusqu'à un certain degré d'exactitude, ~~mes~~ mes vues se sont portées sur les causes qui y produisent des anoma-lies, souvent assez grandes, tant qu'on n'a point d'autres ~~G~~uides que le Baromètre & le Thermomètre, & c'est un des objets ~~dont~~ que j'ai traités dans les Memoires au Journal de Nicholson, que M. Pictet a entrepris d'extraire pour la Bibl. Britann.

Ma fille vous renouvelle ici qu'elle ne vous a pas oublié, & je suis sincèrement

Monsieur

Votre très-humble & très obeissant Serviteur
DeLuc

Londres le 20e May 1783

Trois lettres que je viens d'écrire, mon cher ami, et en particulier celle qui renfermera celle-ci, ont beaucoup abregé le tems que je puis te donner. Mais je n'en ai pas besoin pour te dire combien j'ai eu de plaisir d'ap=prendre ton heureuse arrivée, & combien j'ai éprouvé de bonheur en vous accompagnant ton cher frère & toi dès le Pacquebot! Quelle charmante idée ce bon Deluc!

Il faut vite que je te dise deux choses, de peur de les oublier. La première que j'ai le reçu du capne du Vaisseau pour Brême. La seconde que je suis surpris, qu'entre les personnes que vous avez vues à la Haye, tu ne nomme point Mr. & Mad. Penenoh. Ne les oubliez pas en revenant, & faites leur mille amitiés de ma part.

Je ne te dirai rien non plus de Mad.e Delafite; tout est dans le billet ci-joint que je viens de recevoir d'elle.

Je suis revenu aujourd'hui de Windsor, où j'étois allé pour la naissance de la Reine; Dieu merci LL. MM. & tout le reste de la famille royale sont très bien.

J'ai reçu des nouvelles de ta chère Soeur, qui se porte toujours très bien Dieu merci. J'en ai aussi reçu de ton Oncle Deluc, l'un de mes correspondans qui se plaignent de mon silence; je suis occupé à reparer tout cela. Il me marque la mort du pauvre Pictet Desaussure, trouvé au bord du lac, étendu sur le gravier la tête dans l'eau, avec toute l'apparence d'un accident, d'une attaque d'apoplexie. On lui a ouvert la tête, & l'on a trouvé la dure mère, enveloppe extérieure du cerveau, adhérente pres=que par tout au crane; ce qui semble expliquer les étranges écarts de sa tête. Cette mort m'a occasionné une peine; non en elle-même, qui est un bien pour ce pauvre souffrant; mais en ce que son héritier, Mr. Pictet Plantamour, me demande déjà le rembours d'un billet de 1200tt. cour. que je lui devois avec interêts. Il m'en coute beaucoup de repens; mais j'y suis forcé par ma situation.

Tu penses bien que je vais en avant pour l'Electricité, & en effet je vais sans cesse faisant de nouvelles machines. Je n'y ai -

point de regret; parce que c'est une occupation agréable, & que la chose même va ainsi de mieux en mieux.

Chargez vous l'un ou l'autre, mes chers amis, de bien des choses pour Mons Cuidere. Pensez avec quelle ardeur je vous presse sur mon sein! J. A. Dehau.

A Monsieur
Monsieur Jean De[illegible]
à Amsterdam

R. 27
Mon Père
Londres le 20 mai 1783

Bath 14 Octobre 1784
Mon Père
R. 20 [illegible]

Care Monsieur

Monsieur Jean Deluc
chez Messieurs Vve de la Coudre & Lorrdon
à Amsterdam

15 OC

Bath le 12.e 8bre 1784
pour le 14.e

Mon cher ami —

Pour avoir voulu t'écrire plus tôt, tu auras reçu ma lettre plus tard. Dès que je reçus ici ta lettre d'Ostende du 19.e 7bre, je t'écrivis à Rotterdam à l'adresse de Mr Van Lieudert le 27.e 7bre; & par ta lettre du 27.e 7bre de la Haye, je vois que tu fais ton chemin plus rapidement que je ne l'avois imaginé. Mais sans doute que tu auras laissé les ordres nécessaires pour que tes lettres te suivent: c'est une attention qu'on doit toujours avoir en voyage; car mille choses peuvent retarder les lettres, ou leur départ. Par exemple. Je voulois t'écrire le courrier dernier, & je ne le pus pas. Je voulois t'écrire celui-ci; mais comme rien ne me marque les jours ici, je me suis trompé d'un; c'étoit hier que je devois t'écrire; & pour n'être pas exposé au même inconvenient je prépare ma lettre pour le courrier prochain. —

Il me semble, mon cher ami, que tu marches trop vîte. Le 19.e 7bre à Ostende, & le 27.e déjà à la Haye, ne t'a pas donné assez de tems à Anvers & surtout à Rotterdam. Comme je ne sais pas tes raisons, je ne te blâme pas; mais j'en veux prendre occasion de te dire; que tu dois nécessairement chercher partout l'occasion de te lier avec les Négocians, pour les entendre parler des affaires. C'est _par hazard_ qu'on apprend dans la Conversation, & il faut ouvrir la porte à ces heureux hazards en leur donnant _du tems_. Les connoissances que tu veux acquerir, ne sauroient donc absolument être acquises à la hâte. Si c'étoit des affaires à faire, on les accélère avec de l'activité, & l'on gagne du tems. Mais dès que ce sont des connoissances à acquérir, la marche doit être toute différente; je te prie d'y songer, de te surmonter absolument à cet égard; de te mêler avec les Négocians, d'accepter leurs invitations, de les rechercher, d'aller aux Lieux où ils s'assemblent, Bourses, Caffés &c —

de ne te point déterminer à partir, parce que tu ne vois plus rien à faire ; car si c'est peu à près être arrivé, c'est une preuve que tu n'as encore rien fait. Souvent après huit jours de séjour, rien ne se sera présenté à tes observations qui te paroisse digne de te retenir. Le neuvième tu feras connoissance avec une nouvelle personne, dont la conversation t'intéressera. Tu te lieras avec elle, tu apprendras des choses que tu ignorois, qui te donneront des fils, & tu resteras peut-être un Mois, où tu avois trouvé d'abord que quelques jours étoient trop. Je ne puis donc que regretter que tu aie demeuré si peu à Anvers & à Rotterdam. Le départ de Mr Van Lienderts pour venir à la Haye n'étoit pas, en soi, une circonstance déterminante, pour quitter si tôt un lieu où il se fait tant de commerce. J'insiste sur cela dès le commencement, afin que mes Reflexions puissent te servir ~~pour~~ dans ta marche future. Car tu sens qu'il faut bien faire ce que tu fais.

J'ai reçu la réponse de mon ami le Dr Marcard de Hanovre. Tu seras très bien reçu par ses Parens à Stade. Tu auras un appartement agréable, & une Maison voisine, où tu trouveras toujours une Compagnie fort honnête. Il y a un Maître pour l'allemand, qui sait l'anglois & le François de qui tu prendras des leçons. Toute la famille de Mr. Marcard s'empressera à t'obliger : & lorsque tu sera près d'arriver à Stade ; comme par exemple d'Emden, tu previendras de ton arrivée le Frère aîné de mon ami, Mr. Marcard, Secretaire des Etats provinciaux du Duché de Brême & Verden à Stade.

Madlle Schoellenberg ne se rétablit pas comme d'ordinaire dans ce voyage ici ; elle est toujours très souffrante. Notre chère Franchette, qui vous embrasse tous les deux de tout son coeur, m'aide à remplir les devoirs de ma présente vocation. C'est par elle que j'ai un peu de tems pour mon ouvrage, & pour faire les promenades sur une Colline voisine où demeure Miss C. La Santé de celle-ci est mieux qu'à l'ordinaire ; & elle est toujours résolue à m'aider à jouir d'une vie domestique, dont j'ai tant besoin. Je viellis ; je n'ai aucune perspective de voir mon état, commun avec celui de ta Sœur, devenir tel que nous puissions vivre ensemble. Une amitié de onze ans, née par conséquent dans un tems où j'avois plus de vie, & qui à mon age seroit irréparable, m'offre ces douceurs domestiques, qui deviennent nécessaires à un homme qui s'avance vers la vieillesse. Mais nous ne pouvons pas nous établir ensemble, sans que je jouisse de toute ma pension. Aucun d'eux n'a moins songé à lui avant ses Enfans, & je ne murmurerai jamais tant qu'il sera nécessaire que je vous assiste. Mais je ne puis m'empêcher de desirer, pour vous-mêmes comme pour moi, que vous fassiez gaîment des efforts pour vous tirer d'affaire pour vous-mêmes, afin que je puisse commencer à jouir de quelque repos d'esprit & me voir fixé domestiquement. Gaîment, dis-je ; car vos tristesses m'oppriment ; non seulement comme faisant votre malheur présent ; mais comme étant le plus grand obstacle à vos progrès. Je te répète donc ce que je te marquois dans ma lettre adressée à Rotterdam. Que vous tâchiez avec notre cher Deluc, d'arranger les choses de manière à ce qu'il se trouve immédiatement utile, afin que je puisse lui procurer ses dépenses ; & qu'ainsi je voie arriver le moment auquel tient mon propre arrangement avec Madlle C. & ta Sœur. Elles sont & seront de plus en plus fort bonnes amies.

Cette lettre te sera commune avec mon cher Deluc, à qui tu peux faire ~~la~~ confidence de Miss C. quoique ta Sœur n'en sache encore rien. Je t'embrasse de tout mon coeur, comme il pou[...] penser. Comme tu auras à tirer pour tes dépenses, j'ai[...] qui est nécessaire pour le mettre ~~&~~ à jour à l'égard des tien[...] en le distinguant dans la note que vous me donnerez.

Si je reçois quelque lettre de votre part avant que de fermer celle-ci, je te le dirai au bas. Adieu mes bien chers amis, Dieu vous benisse !

J. A. Deluc

Je n'ai point reçu de lettre de Madm. Mackay.

Tu comprend que, sans entrer ici dans des détails, je te charge de mes complimens de tout genre pour toutes les personnes que j'aime & respecte à Amsterdam

DE LUC, Jean André, Entdecker der Anomalie der Ausdehnung des Wassers, 1727—1817. 2 e.Br.m.U. London 20. V. 1783 und Bath 12. X. 1784. Zus. 4 S. 4⁰, eng beschrieben. Mit Adresse. (80.—)

An seinen gleichnamigen Sohn in Amsterdam.

STARGARDT-61

1783. „. . . *Tu penses bien que je vais en avant pour l'Electricité, & en effet je vais sans cesse faisant de nouvelles machines. Je n'y ai point de regret; parce que c'est une occupation agréable & que la chose même va ainsi de mieux en mieux* . . ."

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Briefe an De Luc s. Nrn. 295, 307, 330, 425/27, 457, 458, 475 und 494.

DELUC

A.L.S. to Dr. Alex Marcet
Dated 1811

Sur La Pile Galvanique

1811—1833. Zus. 47 S. 4⁰. Zum Teil mit Adressen. (12

11 Briefe (1811—1831) sind an Göschen gerichtet, 7 an den Buchhändler Barth in Leipzig (1825/26). Eichstädt in Jena (1826—1833) und je 1 an den Geographen und Geschichtsforscher Karl Friedrich Klöden (1823) und an den Arzt Christoph Eusebius Raschig (1823).
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455 CHLADNI, Ernst, Entdecker der nach ihm benannten Klangfiguren, 1756—1824. E. Ma skript m.U. O.O. Februar 1821. 8¼ S. 4⁰. (150

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DEL&